DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE – 637 215.

COURSE / LESSON PLAN SCHEDULE

16EE713 - INDUSTRIAL AUTOMATION AND CONTROL

NAME: Dr.M.Vijayakumar **CLASS: IV-EEE**

LEGEND:

L - Lecture
T - Tutorial
OHP - Over Head Projector
Rx - Reference
PPT- Power Point
BB- Black Board
pp- Pages
Ex- Extra

S.No.	Lecture Hour	Topics to be covered	Teaching Aid Required	Book No. / Page No.
UNIT I INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER (PLC)				
1.	L1	Introduction - PLC Evolution	BB & PPT	Tx1/pp 4-6
2.	L2	PLC Vs Computers	BB	Tx1/pp 13-14
3.	L3	Block Diagram of PLC	BB	Tx1/pp 6-10
4.	L4	PLC Hardware Components: I/O modules	BB & PPT	Tx1/pp 22-31
5.	L5	Power Supply	BB & PPT	Tx1/Ref. 2
6.	L6	Power Supply	BB & PPT	Tx1/Ref. 2
7.	L7	CPU	BB	Tx1/pp 36-38
8.	L 8	PLC size and Applications	BB & PPT	Tx1 /pp 14-15
9.	L 9	PLC Programming Languages	BB	Tx1/pp 105-109
UNIT II LOGIC FUNDAMENTALS, TIMER AND COUNTER				
10.	L10	Logic functions – Boolean instructions and functions	BB+PPT	Tx1 /pp 72-79
11.	L11	Hardwired logic Vs Programmed Logic	BB+PPT	Tx1 /pp 80-85
12.	L12	Developing circuits from Boolean instructions	BB+PPT	Tx1/pp 79-80
13.	L13, L14	Programming Word Level Logic Instructions	BB+PPT	Tx1/pp 86-87
14.	L15, L16	PLC timer: classification and instructions	BB+PPT	Tx1/pp 173-191
15.	L17	PLC counter	BB+PPT	Tx1/pp 204-205
16.	L18	PLC counter classification, instructions and applications	BB+PPT	Tx1/pp 204-222

UNIT III PLC PROGRAMMING				
17.	L 19	PLC-memory map	BB+PPT	Tx1/pp 38-41
18.	L20	Program scan	BB	Tx1/pp 102-105
19.	L21	Relay type instructions	BB & PPT	Tx1/pp 109-112
20.	L22, L23	Instruction addressing	BB & PPT	Tx1/pp 112-113
21.	L24	Branch instructions	BB & PPT	Tx1/pp 113-116
22.	L25	Internal relay instructions - EXAMINE IF CLOSED and EXAMINE IF OPEN instructions	BB & PPT	Tx1/pp 116-118
23.	L26	Modes of operation	BB	Tx1 /pp 122-123
24.	L27	Basic relay ladder logic and its control flow chart	BB	Tx1/pp 160-161
UNIT IV DISTRIBUTED CONTROL SYSTEM				
25.	L28	Distributed control system : Evolution	BB	Tx2 /From net source
26.	L29	Architectures – Comparison	BB & PPT	Tx2 /From net source
27.	L30	Local control unit	BB & PPT	Tx2 /From net source
28.	L31	Process interfacing issues	BB & PPT	Tx2 /From net source
29.	L32	Communication facilities	BB & PPT	Tx2 /From net source
30.	L33	Low and high level operator interfaces	BB & PPT	Tx2 /From net source
31.	L34	Operator displays	BB	Tx2 /From net source
32.	L35	Low and high level engineering interfaces	BB	Tx2 /From net source
33.	L36	General purpose computers in DCS – Bus Standards. Introduction to SCADA	BB	Tx2 /From net source
UNIT V APPLICATIONS OF PLC AND DCS				
34.	L37	PLC interfaces	BB	Tx1 /pp 372-375
35.	L38	PLC applications	BB	Tx1 /pp 156-159
36.	L39	Automatic Control Of Ware House Door	BB & PPT	Omron C20 user manual pp 6-1 to 6-2
37.	L40	Automatic Lubricating Oil Supplier	BB & PPT	Omron C20 user manual pp 6-3
38.	L41	Conveyer Belt motor Control	BB & PPT	Omron C20 user manual pp 6-4 to 6-5
39.	L42	Automatic Car Washing Machine	BB & PPT	Omron C20 user manual pp 6-6
40.	L43	DCS applications	BB & PPT	Tx2 /From net source
41.	L44	Pulp and paper environment	BB & PPT	Tx2 /From net source
42.	L45	Petroleum and refining environment	PPT	Tx2 /From net source

Text Books :

1 Frank D.Petruzella, Programmable Logic controllers, Mc.Graw-Hill, Third Edition,Sixth Reprint, 2013

2 Lucas M.P., Distributed Control System, Van Nostrand and Reinhold Co.Newyork, 1986.

Reference Books :

1 Gary Dunning, Introduction to Programmable Logic Controllers, Thomson, Third Edition, 2010

2 John W.Webb, Ronald A.Reis, Programmable Logic Controllers: Principles and Applications, PHI Private Ltd., Fifth Edition, 2003

3 W.Bolton, Programmable Logic Controllers, Elseveir, Fourth Edition, 2008

4 Madhuchhanda Mitra, Smarajit Sen Gupta, Programmable Logic Controllers and Industrial Automation, PRI Pvt Ltd., 2009

K.S.R. COLLEGE OF ENGINEERING, TIRUCHENGODE-637215

(AUTONOMOUS)

Seventh Semester

B.E.-ELECTRICAL AND ELECTRONICS ENGINEERING

16EE713- INDUSTRIAL AUTOMATION AND CONTROL

(Regulations 2016)

Question Bank

Year : IV year (2019-2020) ODD SEMESTER

UNIT I: Introduction to Programmable Logic Controller (PLC)

PART-A (Q&A)

1. **Briefly explain about timers in PLC. (Understanding)**

The operation of time-delay relays is provided in software. The contacts are shown as NO or NC designations. Only the address to the relay coil shows that it is a timer contact. The timer is activated by a condition in a rung that leads to the timer being energized. Then the indicated time delay (in seconds or minutes) is inserted before the associated contacts change state.

2. **How do you choose the PLC for a particular application? (Understanding)**

The selection of PLC based on

i) The number of input and output used ii) The control strategy

iii) Working environment of the system iv) Cost factor.

3. **What is the difference between PLC and Computer? (Rem.)**

The major difference between PLC and computer are,

1. PLC can accommodate industrial environment that will stand relatively high temperature, humidity, moisture etc.
2. Programming of PLC is easier than Computer.
3. All the field point inputs and outputs are directly connect to PLC. There is no need of signal conditioning.)

4. **What is latch? Where it is used? (Remembering)**

Latch is a hardware or software device which uses to maintain the state unless the next state is generated. In PLC operations the relay contact need not be placed directly over the coil symbol, but can go anywhere in the program with associated them with a particular coil.

5. **What are the different methods in PLC programming? (Rem.)**

The different methods of PLC programming are

i) Ladder program ii) Functional block diagram iii) Statement list.

6. **Briefly explain about counters in PLC. (Und.)**

The counter works in a similar fashion as timer expect that it is counting of events that determine when the associated contacts change state. Thus, if the counter is loaded with the number 10, after being energized 10 times the associated contacts will be changed. Counters can be configured to count up, count down, count from preset values, and be reset before the count is finished.

7. What are the advantages and disadvantages of PLCs? (Rem.)

Advantages

a. Flexibility
b. Implementing changes and correcting errors
c. Large quantities of contacts
d. Lower cost
e. Simplicity of ordering control system components
f. Ease of changes by reprogramming

Disadvantages

a. Fail safe operation
b. Fixed circuit and fixed program applications
c. Environmental considerations
d. Newer technology

8. What is program scan? (Rem)

During each operating cycle, the processor reads all the inputs, takes these values and energizes or de-energizes the outputs according to the user program. This process is known as a *scan.* A single PLC scan, which consists of the I/O*scan* and the *program scan.* Because the inputs can change at any time, the PLC must carry on this process continuously.

9. What is PLC? (Rem.)

Programmable Logic Controller (PLC) is a user friendly electronic computer that carries out control functions of many types and levels of complexity. It can be programmed, controlled and operated by a person unskilled in operating computers.

10. What is ladder diagram? (Rem.)

Ladder diagrams are the most commonly used diagram for non-electronic control circuits.

They are sometimes elementary diagrams or line diagrams. Sometimes they are considered a subtype of schematic diagrams. The PLC program is look like ladder in a way. The program starts at the top of the ladder and generally works down as our requirement.

11. List the functions of PLC programming device. (Und.)

The programming device is a device used to load the program into the processor. It can be a PC or a dedicated piece of equipment made by the PLC manufacturer. It makes the PLC reprogrammable and thus flexible.

12. Mention any 2 differences between PLC's and general purpose computers: (Und.)

(i) PLC is designed to operate in the industrial environment with wide range of ambient temperatures and humidity. A well-designed PLC is not affected by the electrical noise that is inherent in most industrial locations.
The electrical noise and extreme temperatures affect computers.

(ii) PLC's execute a single program in an orderly and sequential fashion from first to last instruction, whereas computers are complex computing machines capable of executing several programs or tasks simultaneously in any order.

13. **List the features of PLC**. (und.)

The programmable controller has eliminated much of hand wiring associated with conventional relay control circuits. It is small and inexpensive compared to relay based process control systems. Programmable controllers also offer solid-state reliability, lower power consumption and ease of expandability.

14. **List the different types PLC programming methods**. (und.)

The different methods of PLC programming are

1. Ladder Logic(LAD)
2. Functional Block Diagram (FBD)
3. Statement List(STL)

15. **List out any four PLC input and output devices. (Und.)**

Input: i) Push button, ii) Limit switches, iii) Toggle switches iv) Pressure limit switch.
Output: a. Control relay b. Pilot lamps c. Solenoid d. Alarm.

16. **Enlist the advantages of PLC over relay ladder logic.**

Relays	PLC
• They have to be hard-wires to perform a specific function. • When the system requirements change, the relay wiring has to be changed or modified. • Higher power consumption.	• No hard-wire requirement. • Can be easily changed or expanded. • Lower power consumption.

PART B

1. Draw the architecture of PLC and explain individual components. (Und.)

2.(i) Explain how to convert the fundamental relay schematic diagrams in to PLC ladder logic diagram with an example. (8) (Und.)

(ii) Design a PLC program to operate a light according to the following sequence

- A momentary push button is pressed to start the sequence.
- The light is switched on and remains ON for 2sec.
- The light is switched off and remains OFF for 2sec.
- A counter is incremented after this sequence.
- The sequence then repeats for a total of 4counts.
- After fourth count, the sequence will stop and the counter will be reset to zero.(8) (Creating)

3. (i) With neat block diagram, discuss the various components of PLC. (Und.)
(ii) Sketch and explain the functions performed by analog I/O module. (Und.)
4. (i) How timers and counters are programmed in PLC? Illustrate with an example.(6)(Und.)
(ii) Develop ladder diagram for controlling the level of liquid in a tank between upper and lower limit. (Apply)
5. (i) Explicate with neat block diagram power supply used for PLC (Und.)
(ii) Explain the architecture of PLC with neat diagram. (10) (Und.)
6. What is the purpose of input status table and output status table in PLC and write any PLC program using timer and counter applications. (Und.)
7. (i) Comment on the advantages of PLC over relay logic. (Und.)
(ii) Discuss analog input interface module. (Und.)
(iii) With logic ladder program and a timing chart explain Retentive On-Delay Timer.
8. (i) Design a PLC program and prepare a typical I/O connection diagram and logic ladder program for the following control specification (Apply)
(1) To fill the tank with the liquid
(2) Heat the liquid to a particular temperature and stir the liquid.
(3) Maintain the temperature for 15minutes.
(4) Empty the tank.

10.(i) Write about advanced PLC functions and alternative programming languages. (U)

UNIT II: Logic Fundamentals, Timer and Counter

PART-A (Q&A)

1) What are basic properties of Boolean algebra? (Rem.)
The basic properties of Boolean algebra are commutative property, associative Property and distributive property.

2) State the associative property of boolean algebra. (Und.)
The associative property of Boolean algebra states that the OR ing of several variables results in the same regardless of the grouping of the variables. The associative property is stated as follows: A+ (B+C) = (A+B) +C

3) State the commutative property of Boolean algebra. (Und.)
The commutative property states that the order in which the variables are OR ed makes no difference. The commutative property is: A+B=B+A

4) State the distributive property of Boolean algebra. (Und.)
The distributive property states that AND ing several variables and OR ing the result With a single variable is equivalent to OR ing the single variable with each of the the several Variables.

5) Write a simple program using PLC to implement the OR logic gate. (Und.)

6) List the different types timers used in PLC. (Und.)

In general, there are three types of PLC timer delays, ON-delay timer, OFF-delay timer and retentive timer on.

7) What is retentive timer in PLC? (Rem.)

The retentive timer operates the same as a TON timer except that the accumulator is not reset when the timer enable goes to 0 and continues to increment whenever the enable bit goes to 1. When the accumulator bit reaches the preset value, the timer timing bit goes to 0 and the done bit to 1 and the accumulator bit remains in that state until a reset instruction is received.

8) What are counters in PLC? (Rem.)

A counter is a PLC instruction that either increments (counts up) or decrements (counts down) an integer number value when prompted by the transition of a bit from 0 to 1 (“false” to “true”). Counter instructions come in three basic types: up counters, down counters, and. up/down counters.

9) What is the use of timer in PLC? (Rem.)

PLC timers are instructions that provide the same functions as on-delay and off-delay mechanical and electronic timing relays. A PLC timer provides a preset delay to the control actions.

10) List the different types of counters. (Und.)
A counter is a PLC instruction that either increments (counts up) or decrements (counts down) an integer number value when prompted by the transition of a bit from 0 to 1 (“false” to “true”).
Counter instructions come in three basic types:

1. up counters, 2. down counters, and 3.up/down counters.

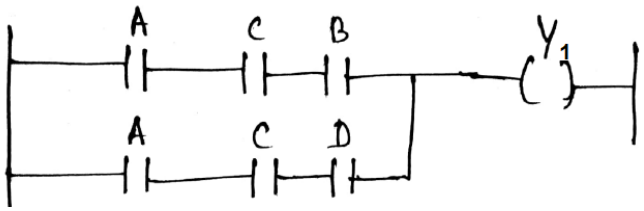
11) Compare T_{on} and T_{off} Timer (Und.)

T_{on} timers	T_{off} timers
• When the coil is energized, the timed contacts are prevented from opening or closing until the time delay period has elapsed. • When the coil is de-energized, the timed contacts return instantaneously to their normal state.	• When the coil is de-energized, the timed contacts are prevented from opening or closing until the time delay period has elapsed. • When the coil is energized, the timed contacts return instantaneously to their normal state.

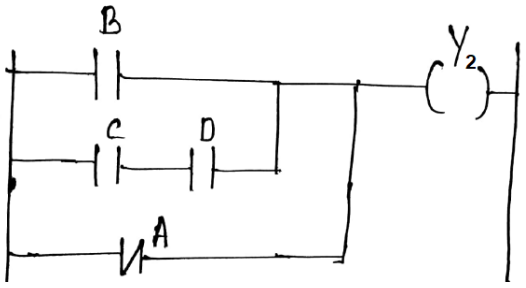
12) Compare programmed logic and hard wired logic. (Und.)

S.No.	Programmed Logic	Hardwired Logic
01.	Operation can be easily changed by changing the program.	The operation cannot be changed easily.
02.	Fault location and rectification is easy.	Fault location and rectification is not easy.
03.	Power consumption is less	Power consumption is more
04.	Less physical wiring is used	More wiring is used
05.	Installation of PLC is very easy	Installation is completed
06.	Less maintenance	More maintenance
07.	Low operating cost	High operating cost

13) Write a ladder for the Boolean logic Y=(ACB+ACD). (Apply)



14) Write a ladder for the Boolean logic Y2= A'+(B+CD). (Apply)



PART-B

1) Develop the circuits from the following Boolean instructions. (Apply)
(i)Y= (A+B)C (ii) Y= (ABC)+D (iii) Y= (A+B+C)D

2) Write the programming word level logic instructions for OR, AND and XOR logics. (Apply)

3) Describe the different types of timers with their instructions are used in PLC. (Und.)

4) Give the suitable applications for ON delay and OFF delay timers used in PLC. (Apply)

5) Give the suitable applications for retentive timers used in PLC. (Apply)

6) Describe the different types of counters with their instructions are used in PLC. (Und.)

7) Give the suitable applications for UP and DOWN counters used in PLC. (Apply)

8) Give the suitable applications for UP /DOWN counters used in PLC. (Apply)

UNIT III: PLC Programming

PART-A (Q&A)

1. What is ladder diagram? How is it useful in a PLC? (Rem.)

Ladder logic is a graphical language. The programmer draws a schematic diagram of logic on the screen. This diagram is called as the ladder logic diagram and determines the sequence of operation and ultimate control of equipment or machinery.

2. List the sequence of operations carried out in PLC programming. (Und.)

- Processor memory organisation.
- Program scan.
- PLC programming language.
- Relay type instruction.
- Instruction addressing.
- Brach instruction.
- Internal relay instruction.
- Programming examine ON and OFF instructions.
- Entering the ladder diagram.
- Modes of operation.

3. List the conditions for drawing the ladder logic. (Und.)

- Contacts may be always inserted in the upper left.
- Coils must be inserted at the end of a rung.
- All contacts must run horizontally. (i.e.) No vertically oriented contacts are allowed.
- The number of contacts per rung is limited.
- Only one output may be connected to a group of contacts.
- The contacts must be nested.
- Flow must be from left to right.
- Contact progression should be straight across.

4. What is meant by internal relay instruction? (Und.)

Most PLCs have an area of memory allocated for what are known as internal storage bits. These storage bits are also called internal outputs, internal coils, internal control relays are just internals. The internal output does not directly control an output device.

5. What is fail safe circuits? (Und.)

Some PLC circuits are programmed to be turned off by applying a signal voltage. For example the latch-unlatch function requires an unlatch signal to turn

the coil .If there is a loss control power, pushing the stop button has no effect and coil remains on, since control power is needed for system turn off, the emergency switch to stop machine where it is.

6. What are I/O scan and Program scan as applied to PLC's? (Rem.)

The execution cycle starts with the hardware I/O system gathering the latest values of all input signals and storing them in a fixed region of memory. This process is called the I/O scan. During the program scan, new values of physical outputs, as determined from the various ladder rungs are initially written into the output memory region and when the program is completed; all output values are written to the physical output by PLC hardware in 1operation.

7. What are the advantages of sequencer programming over conventional programming? (Rem.)

The advantage of sequencer programming over the conventional program is the large savings of memory words. Typically, the sequencer program can do in 20 words what a standard program can do in 100 words. By setting up a sequence of events, sequencers make programming simpler and any future changes easier to make.

The sequencer output (SQO) instruction can be used to control output devices sequentially. The desired sequence of operation is stored in a data file, and this information is then transferred sequentially to the outputs.

8. What is the main advantage of JUMP instruction? (Rem.)

The advantages to the jump instruction include:

- The ability to reduce the processor scan time by jumping over instructions not pertinent to the machines operation at that instant.
- The PLC can hold more than one program and scan only the program appropriate to operator requirements.
- Sections of a program can be jumped when a production fault occurs.

9. Name the various sequence instructions used in PLC. (Und.)

Mechanical cam operated sequencer, Mechanical drum operated sequencer, programmed sequencer.

10. What are the functional areas in which the programmable controllers are used in many industries? (Und.)

The PLC has been successfully used in many industries includes steel plant, paper and pulp plants, Chemical, automotive and power plants. PLC performs a great variety of control tasks, from repetitive ON/OFF control of a simple machine to sophisticated manufacturing and process control.

11. What advantage is there to the nesting of subroutines? (Rem.)

Nesting subroutines allow you to direct program flow from the main program to a subroutine and

then to other subroutine. Nested subroutines make complex programming easier and program operation faster because the programmer does not have to continually return from one subroutine to enter another.

12. What are the limitations of using relay circuits for sequencing operation?(R)

Separate hard wiring is required and one application can be adopted at a time.

13. What do you mean by relay logic? (Rem.)

The different symbols are followed for inputs and outputs unlike ladder logic.

14. Mention any four real time applications of PLC. (Und.)

- Sequence control, timing, counting, and data calculation.
- Batch or continuous process control.
- Precise position / motion control.

Open loop or feedback control, process data acquisition and display

PART-B

1. Describe the function of program control instructions and develop a program to illustrate their use. (Und.)

2. (i) Develop the logic ladder diagram for liquid level control application. (10) (Apply)
(ii) How to use a PC as a PLC? (6) (Und.)

3(i) Mention the inputs and outputs used in a bottling application and write a program using RLL.(8) (Und.)
(ii) Write a PLC ladder diagram for a process application of your choice. Mention the I/Os. (8) (Apply)

4.(i) Discuss the use of math instructions of PLC for automatic control of upper and lower set point limits. (Und.)
(ii) With an example, explain function block programming for sequence control application.
(i) Discuss the various types of programming terminals and devices used in programmable controller systems.(Und.)
(ii) Write a detailed technical note on requirement of communication networks of PLC. (Und.)

5.(i) Explain how hardware-to-program interface and program-to-hardware interface are established in a PLC. (Und.)
(ii) Propose and explain a safeguard technique for diagnosing failure in the I/O unit of a PLC. (Und.)

6.Describe the branch instructions used in PLC programming. (Und.)

7. Describe the relay type instructions used in PLC programming. (Und.)

8. Explain the modes of operation of PLC. (Und.)

UNIT IV: Distributed Control System

PART-A (Q&A)

1. What is the significance of DCS? (Rem.)

Used for interfacing and computing functions and also provides the means of communication between the other devices. It consists of local control unit, low level interface, high level interface, shared communication facility, etc.

2. Mention any two advantages of DCS. (Rem.)

- More reliable Small expensive
- Cost is lower than centralised system which is performing same function.

3. What is LCU? (Rem.)

Local control unit is the small collection of hard ware in the system that can do closed loop control. Local control unit interfaces directly to the process.

4. What is the significance of LLHI? (Rem.)

This is the device that allows the operator or instrumentation engineer to interact with the LCU to change set point, control modes, control configuration, or tuning using a direct connection. LLHI can also interface directly to the process.

5. What is the function of HLOI? (Rem.)

It has the functions similar to the LLHI with increased capacity and user with increased capability and user friendliness. It interfaces to other devices only over the shared communication facilities. Operator oriented program at this level is called HLOI. It is an instrument engineer oriented program.

6. What is shared communication? (Rem.)

One or more communication hardware and associated software that allow the sharing of data among all devices in the distributed system. Shared communication facilities do not include dedicated communication channels between specific devices.

7. What is the need can be satisfied in designing an industrial grade LCU? (Rem.)

- flexibility of changing the control configuration
- Ability to use the controller without being a computer expert.
- Ability to bypass the controller in case it fails. So that the process still can be controlled manually.
- Ability of the LCU to communicate with other LCUs and other elements in system.

8. What is the architecture parameter to be considered while selecting LCU? (Rem.)

- Size of Controller
- Functionality of controller
- Performance of controller
- Communication channels out of controller
- Controller output security.

9. What are the approaches in designing a redundant LCU architecture? (Rem.)

a)CPU redundancy b) One-on-one redundancy
c) One-on-many redundancy d) Multiple active redundancy.

10. What are multiple active controllers? (Rem.)

In this case, several LCUs are active at the same time in reading process inputs calculating control algorithms and producing control outputs to the process. The multiple active approaches is designed so that a failure of one of the controllers does affect the automatic control function.

11. Compare the configuration of the controller. (Und.)

Architecture parameter	Configuration A	Configuration B	Configuration C
Controller size	Number of function needed for single PID loop or motor controller	Includes functions and I/O	Equivalent to small DDC system
Controller functionality	Uses both continues and logic function	Uses both continues and logic function Split between the controller	Uses both continues and logic function
Controller scalability	High degree of scalability	Requires both controller types	Not scalability

12.Mention the requirement of operator interface. (und.)

- Process monitoring
- Process control
- Process record keeping

13.What are the motivations for using LLOI? (Rem.)

- It provides an interface that is familiar to the operator trying to use panel board instrumentation.
- Less expensive
- Provide manual back up in the case if high level operator interface fails.

14Explain about different types of operator display. (Und.)

- Plant display,
- Area display.
- Group display.
- Graphic display.
- Trend display.
- Tabular display.

- Loop display.

15. What is the function of engineering interface? (Rem.)

- System configuration
- System documentation
- Operator configuration
- System failure diagnosis

16. List the factors to be considered for types of communication in DCS. (Und.)

There are many factors to take into account when choosing the best medium for particular application, including speed and distance of data transmission, topology of the network, and target costs.

17. Define Distributed Control System? (Und.)

DCS (Distributed Control System) is computerized control system used to control the a production line in the industry. The entire system of controllers is connected by networks for communication and monitoring. DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment.

18. Name few popular communication buses used in DCS.(Und.)

- Control Bus
- Address Bus

EEE 488 BUSData Bus

19. Compare individual, centralized and distributive control systems.(Und.)

Features	Individual	Centralized	Distributed
1. Scalability and expandability	**Good** - due to modularity	**Poor** –very limited range of system size	**Good** - due to modularity
2. Control capability	**Limited** –analog and sequential control hardware	**Full** - digital control capability	**Full** - digital control capability
3.Operator interfacing capability	Limited by panel board instrumentation	Digital hardware provides significant improvement for large systems	Digital hardware provides improvement for full range of system sizes
4. Integration of system functions	**Poor** - due to variety of products	All functions performed by central computer	Functions integrated in a family of products

20.What is the role of communication interfaces in DCS? (Rem.)

Communication interface reduce Cost of plant wiring (1000 of wires are replaced by the few cablesorbusesusedtoimplementsharedcommunicationsystem).Flexibilityofmarkingchanges increases because of it is software configuration. Less time to implement large system since the wiring labor is nearly eliminated, Configuration error reduced. Control is more reliable due to reduction in physical connection. So failure is easily identified.

21. Explain about Data Acquisition System. (Und.)

Data Acquisition System is generally a process of collecting input signal in analog or digital form as rapidly, as accurately, completely, and economically as necessary and possible. It is used for the measurement and processing of plant signal data before it is displayed on the operator desk or permanently reordered. It can be of two types: i) Analog

data acquisition system and ii) Digital data acquisition system. Analog data acquisition system deals with information in analog form where as digital data acquisition system handles information in digital forms.

PART-B

1. "Communication plays a critical role in DCS" is it true? Justify with neat sketch. (Und.)
2. Describe the hierarchy of DCS with neat diagram. Explain the architecture of distributed control system and its main sub-system. Compare it with SCADA system. (Und.)
3. Describe the local control unit and communication facilities used in any process industry. (Und.)
4. (i) Explain with neat diagram architecture of DCS.(12) (Und.)
   (ii) Explain the importance of local control unit in DCS. (4) (Und.)
5. (i) How to select topology and communication protocol of process control application?(8) (Und.)
   (ii) Explain any one popular communication protocol used in field level. (8) (Und.)
6. Discuss the different architectures of DCS with necessary diagrams. (Und.)
7. (i) Explain the process interfacing issues in the petroleum industry. (Und.)
8. (i) List the requirements of LCU. (Und.)
   (ii) Compare DCS and DDC.(Und.)
9. Explain the display hierarchy in DCS. (Und.)

UNIT V: Applications of PLC and DCS

PART-A (Q&A)

1. **What is fully automatic system? (Rem.)**
   Most start up modulating and binary controls are executed automatically. Significant improvement of man machine communication with color graphic displays and voice communication. Most plant control sub loop controllers are digital and connected to the unit computer with data busses comprising a distributed digital control system.
2. **What are the main processes of power station? (Rem.)**
   - Combustion, water / steam, electricity generation, cooling etc.
   - For the sub processes are feed water, mills, FD fans etc.
3. **What are the advantages of HIACS 3000 DCS? (Rem.)**
   The use of integrated controllers has reduced the required panel area by 40% Advance prediction control has reduced the control deviation by 50% CRT plant operation reduction of hand/ auto / control station by 71% by using plant communication networks, the number of cables interfacing with DAS was reduced by75%
4. **Mention the hardware's of the power plant DCS and the buses of the power plant.(Und.)**
   - Field stations
   - Sub group control stations
   - Group control stations
   - Unit level control station
   - Manual control station.
   - Diagnostic station.

   buses of the power plant DCS
   - Group bus
   - Peripheral bus

- Plant bus
- Back up bus

5. What are the basic models built for blast furnace? (Rem.)

- Statistical models
- Material and energy balance
- Thermo dynamical models

6. In the steel process, which are all the things to be controlled? (Und.)

- Time, for economical reasons, time element being critical.
- Temperature , with in the narrow limits
- Raw material mix- steel, sulphur, aluminium, manganese and dissolved gases.

7.What are the main and sub process involved in iron and steel process? (Rem.)

- Ore treatment plant
- Electric arc furnace
- Blast furnace
- Continuous casing plant
- Basic oxygen furnace
- Rolling mill
- Direct reduction plant

8.What are the three modes of DCS? (Rem.)

- Computer automatic Manual Automatic and remote

9. Name the functional units in computer control of processes. (Rem.)

CPU, Memory, Mass storage, Communication peripherals, I/O interface.

10.Why is the digital control necessary in industries? (Und.)

Digital Control is a user friendly that carries out control functions of many types and levels of complexity. It can be programmed, controlled and operated easily.

11.What is the need for watch dog timer in a process control computer? (Rem.)

WDT allows the computer to determine if control program is being executed smoothly or if the program is hung up in a never-ending loop. In the second case an alarm alerts the operator that the computer has lost control of the process, due to software problems.

12.Differentiate between analog controller and digital controller. (Und.)

Analog controllers are faster than digital controllers, the later is preferred because the changes in the parameter values are possible in digital controller while not in analog controller.

13.List out the task of computer control systems. (Und.)

- Field level (level-0)
- Plant level (level-3)
- Control level (level-1)
- Corporate level (level4)

Supervisory level (level-2)

14. Briefly explain about Remote Terminal Unit(RTU). (Und.)

The Remote Terminal Units (RTU) are basically distributed SCADA based systems used in remote locations in applications like oil pipelining, irrigation canals, oil drilling platforms etc. they are rugged and should be able to work unattended for a long duration. There are two modes in which Remote Terminal Units work; i) Under command from central computer and ii) Standalone mode.

PART-B

1. Describe the function of program control instructions and develop a program to illustrate their use. (Und.)
2. Construct a PLC program to illustrate the bottle filling process. (Apply)
3. Discuss the automatic bottle filling system with hardware and ladder diagram. (Apply)
4. Develop a ladder diagram for the case given. A switch will increment the counter on when engaged. This counter can be reset by a second switch. The value in the counter should be multiplied by five and then displayed as a binary output. (Apply)
5. (i) Develop the logic ladder diagram for liquid level control application. (10) (Apply)
   (ii) How to use a PC as a PLC? (6) (Und.)

6. (i) Mention the inputs and outputs used in a bottling application and write a program using RLL.(8) (Und.)
   (ii) Write a PLC ladder diagram for a process application of your choice. Mention the I/Os. (8) (Und.)
7. (i) Discuss the use of math instructions of PLC for automatic control of upper and lower set point limits. (Und.)
   (ii) With an example, explain function block programming for sequence control application. (Apply)
8. (i) For the following problem develop PLC ladder logic diagram. (Apply)

   A bottling process for 10 bottles operates as follows: Bottles are counted until all 10 are in position for filling, when in position in the carton the 10 bottles are filled simultaneously for 5 seconds. After filling there is a pause for 2 seconds for foam to subside, the 10 caps are then put on and counted as they are installed. A solenoid then pushes the completed carton of 10 on to a conveyor. The system is reset for a new group (to be restarted manually) of 10 bottles by a limit switch that indicates that the carton is out of the "fill" position and on the conveyor.

   (ii) Comment on the use of PC as PLC. (Und.)
9. (i) Discuss the various types of programming terminals and devices used in programmable controller systems. (Und.)
10. Explain the DCS applications in paper and pulp environment. (Apply)
11. Describe the DCS applications in petroleum and refining environment. (Apply)

Reg. No. :

K.S.R. COLLEGE OF ENGINEERING, TIRUCHENGODE – 637 215

(AUTONOMOUS)

Question Paper Code : 171173

B. E. / B.Tech. DEGREE END SEMESTER EXAMINATION, DEC 2017 / JAN 2018

Seventh Semester

B.E. - ELECTRICAL AND ELECTRONICS ENGINEERING

12EE4703 – Industrial Automation

(Regulations 2012)

Time: Three hours **Maximum Marks: 100**

Answer ALL Questions

PART A — (10 x 2 = 20 Marks)

1. Define program logic controller.
2. List two common types of PLC programming devices.
3. State the Boolean equation for AND, OR & NOT functions.
4. List any four timer functions possible in PLC.
5. Define scan time of PLC.
6. Classify the data files in PLC programming.
7. What is the significance of DCS?
8. Name the few architecture parameters to be considered while selecting LCU.
9. List out the applications of PLC.
10. Recall the three modes of DCS.

PART B — (5 x 16 = 80 Marks)

11. (a) (i) Demonstrate how the I/O modules connect to the processor in a modular-type PLC configuration? (10)

(ii) List four tasks in addition to relay switching that PLCs are capable of performing. (6)

(Or)

(b) (i) Compare the PLC and general-purpose computer with regard to: (10)
(1) Operating environment
(2) Method of programming

(ii) Discuss the physical hardware differences between a PLC and a personal computer. (6)

12. (a) (i) Distinguish between Hardwired logic and programmed logic from Boolean construction. (6)

(ii) Develop the ladder logic for the following functions: (10)
Y1 = (ACB+ACD)
Y2 = A'+(B+CD)

(Or)

(b) (i) Illustrate the basic programming process involved in the cascading of two counters. (10)

(ii) Name three different types of PLC timers. Which of the three is most commonly used? (6)

13. (a) (i) Analyze simple program using EXAMINE IF closed (XIC) instruction. (10)

(ii) Briefly explain the purpose of the user program portion of a typical PLC memory map. (6)

(Or)

(b) (i) Summarize the following terms : (8)
(1) Ladder Diagram
(2) Function block diagram

(ii) Briefly describe each of the following modes of operation of PLCs: (8)
(1) PROGRAM
(2) TEIT
(3) RUN.

14. (a) (i) Discuss the different architectures of DCS with necessary diagrams. (10)

(ii) Summarize the need can be satisfied in designing an industrial grade LCU. (6)

(Or)

(b) (i) Analyze the local control unit and communication facilities used in any process industry. (10)

(ii) Compare individual, centralized and distributive control systems. (6)

15. (a) (i) Examine the features of low level operator interfaces in PLC. (10)

(ii) Justify the need for operator interface in DCS. (6)

(Or)

(b) (i) Show how DCS can be used for controlling paper industries? (10)

(ii) Discuss the PLC based bottle filling system with ladder logical program. (6)

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B. E. / B.Tech. DEGREE END SEMESTER EXAMINATION, DEC 2016 / JAN 2017

Seventh Semester

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

12EE4703 – Industrial Automation

(Regulations 2012)

Time: Three hours **Maximum Marks: 100**

Answer ALL Questions

PART A — (10 x 2 = 20 Marks)

1. Write the hardware components of PLC.
2. Differentiate modular PLC and fixed PLC.
3. Distinguish between hardwired logic and programmed logic.
4. List any four timer functions possible in PLC.
5. What do you mean by scan cycle in PLC?
6. Develop the ladder logic for the Boolean logic OR.
7. Compare centralized control system and distributed control system.
8. List any two process interfacing issues.
9. Give any four applications of PLC.
10. What are the advantages of DCS over PLC?

PART B — (5 x 16 = 80 Marks)

11. (a) (i) Elaborate the architecture of PLC. (8)

(ii) Discuss with neat sketch the discrete input module used in PLC with isolation. (8)

(Or)

(b) (i) Explain about the Central Processing Unit of PLC. (8)

(ii) Summarise the advantages of PLC over relay logic (8)

12. (a) (i) Classify PLC counter with suitable example. (8)

(ii) Develop the ladder logic for the following functions: (8)

Y1 = (ACB+ACD)

Y2 = A'+(B+CD)

(Or)

(b) Classify PLC timer and explain with suitable example. (16)

13. (a) (i) Explain in detail about processor memory organization. (8)

(ii) Write about examine if closed and examine if open with suitable examples (8)

(Or)

(b) Write the ladder logic program needed to implement each of the following: (16)
(Assume inputs A,B, and C are all normally open toggle switches)

(i) When input A is closed, turn ON and hold ON output X and Y until A opens

(ii) When input A is closed either input B or C is open, turn ON output Y; otherwise, it should be OFF.

(iii) When input A is closed or OPEN, turn ON output Y.

(iv) When input A is closed, turn ON output X and turn OFF output Y.

14. (a) Describe about any two architecture of distributed control system. (16)

(Or)

(b) Explain about low level and high level operator interface (16)

15. (a) A bottling process for 12 bottles operates as follows: (16)

- Bottles are counted until all 12 are in position for filling.
- When in position in the carton, the 12 bottles are filled simultaneously for 6.3 seconds.
- After filling, there is a pause of 3.8 seconds for foam to subside.
- The 12 caps are then put on and counted as they are installed.

A solenoid then pushes the completed carton of 12 on to a conveyer. The system is reset for a new group (to be restarted manually) of 12 bottles by a limit switch that indicates that the carton is out of the 'fill' position and on the conveyor. Develop the PLC ladder logic for the above process.

(Or)

(b) Explain the application of distributed control system in paper and pulp industry. (16)

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